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(71) Applicant *(for all designated States except US)*: **CINTEC INTERNATIONAL LIMITED** [GB/GB]; Cintec House, 11 Gold Tops, Newport, South Wales NP20 4PH (GB).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **JAMES, Peter** [GB/GB]; 2 Redd Landes, Shirenewton, Chepstow, Gwent NP6 6QP (GB).

(74) Agent: **HALSTEAD, Richard, Ralph**; Wynne-Jones, Laine & James, Morgan Arcade Chambers, 33 St. Mary's Street, Cardiff CF10 1AF (GB).

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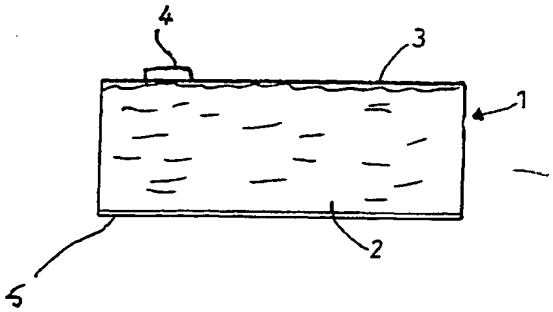
(54) Title: A BLAST-ABSORBING DEVICE



(57) Abstract: According to a first aspect of the invention there is provided a blast-absorbing device (1) comprising a container (3) having an inlet aperture through which pourable material can be introduced into the container, said aperture being closable (4) in order to maintain the material within the container, wherein the material within the container is a settable gel (2) which provides a blast absorbing medium for the blast-absorbing device.

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A Blast-Absorbing Device

This invention relates to a blast-absorbing device, which can be also used to monitor scatter patterns for an explosion and to a blast protection structure, which is formed of a plurality of said blast absorbing devices.

Known structures for absorbing blast from explosions are usually formed of reinforced hardened material, which provide a rigid wall to contain or withstand the blast resulting from the explosion. There are systems that use liquid-filled bags to provide a blast protection shelter but the liquid-filled bags are designed such that on absorbing the blast, the bags are perforated so that the liquid contained within the bags is released. This provides a way of absorbing impact and extinguishing any flames that occur as a result of the explosion. However, once the liquid filled bag is perforated, it cannot be used again safely. A more significant disadvantage is that where the liquid-filled blast protection bags are deployed permanently or semi-permanently around e.g. public buildings or other potential target areas it will be apparent that perforation can be caused by e.g. the use of a knife or a bullet so that a seemingly impregnable installation may rapidly become vulnerable to e.g. a suicide car bomber arriving several minutes after the initial perforation of such bags.

The present invention is therefore derived from the realisation that although liquid-filled bags can be very effective in mitigating against the effects of e.g. bomb blasts and can be rapidly deployed, they are also vulnerable to physical damage prior to carrying out their intended function.

According to a first aspect of the invention there is provided a blast-absorbing device comprising a container having an inlet aperture through which pourable material can be introduced into the container, said aperture being closable in order to maintain the material within the container, wherein the

material within the container is a settable gel which provides a blast absorbing medium for the blast- absorbing device.

In this patent specification, the term "settable gel" is intended to mean any material which is initially in a pourable condition, whereafter it thickens to a consistency which is not pourable but is not hard, or not easily pourable in normal use, such that upon the container being breached by e.g. a bullet or a knife all or substantially all of the material remains within.

By "blast absorbing" is meant blast from e.g. an explosion, but also includes energy from e.g. a vehicle ramming into the blast absorbing device, whether or not such is followed by an explosion.

Preferably, the gel is a starch-based composition and is initially pourable into the container as a liquid which thereafter sets. The starch-based composition may also be provided as a main component that is mixed with other materials, for example other gels, to provide a consistency that is most appropriate for withstanding blast or a particular type of blast. A mixture of gelatine and starch based materials may be used, possibly introduced as layers within a blast absorbing device or alternatively the different materials may be contained within separate compartments of the blast absorbing device.

In a preferred embodiment, the material to form the gel is made from pre-mixed starch and water sold under the name RediBOND 4323A which, when mixed with caustic soda (sodium hydroxide), initially results in a slightly viscose liquid being formed which can easily be poured into the inlet aperture of the or each bag, whereafter it sets into a gel which, depending upon the quantities used, can even be a self supporting gel similar to jelly such that in the event of a bag being ripped, cut or shot at it, it is still substantially self supporting.

However, where proprietary material to form the gel are unavailable or are considered to be too expensive, local materials may be used in substitution,

such as rice, tapioca and sago, which may be used to thicken a water medium in which they are soaked to the required degree.

It is envisaged that the gel may have inclusions interspersed therein, such as gel or polymer beads. These beads may be of a different consistency or viscosity from the surrounding gel, so providing areas within the containers, which can react differently to blast. For example, if hardened gel spheres are used, areas of reinforcement may be provided within the gel. Reinforced areas can be provided in the core of the container so as to provide a final area of blast protection should the surrounding gel be subjected to particularly high levels or sustained explosions. Alternatively, or in addition to the core reinforcement, there may be areas of gel having a different, higher, degree of viscosity or different consistency in proximity to the walls of the container. This will provide areas within the container that can withstand or possibly deflect blast depending on the direction of the explosion.

Ash may be included within the gel material. However, other particulates may be included to provide a suitable viscosity for the gel. The ash or particulates preferably may be at a level of less than 1.0% but if the properties of the gel are to be tailored for a particular application, other levels may be used. The inclusion of particulates such as ash contribute to absorbing blast and help to dampen shock waves that are produced by an explosion.

It is envisaged that the gel may include pockets of air. This has the effect of making the blast-absorbing device lighter so it can be transported more easily but it also provides a combined means of blast absorption by using different types of media, for example the air and the gel. The air may be introduced into the container and bubbles blown into the initial mixture, or depending upon its consistency and setting time, during setting.

In a preferred embodiment, the blast-absorbing device comprises an inflatable container formed of a flexible bag divided into internal chambers in which one chamber is above another. Also, one or more of the chambers may include a reinforcement layer, which could be a lightweight armour material such as Kevlar ®.

The container may have one or more surfaces coated with a non-slip coating which be integral with the material making up the container, or it may be a layer that is applied to the surface of the container post-production. This non-slip coating will allow for blast-absorbing devices to be placed one against the other with a reduced risk of them slipping relative to one another.

It is preferred that where inflatable bags are used for the container, they are formed of a drop-stitch material, which have the effect of keeping the parallel skins of the drop-stitch material parallel to one another when the container is inflated and helps to prevent bulging of the container walls in localised areas, thereby providing a degree of uniformity and strengthening for the blast-absorbing device.

The blast-absorbing device may have an irregular surface contour which can be provided by elements such as tongues, grooves and rebates. By having contoured surfaces, when a container is filled with gel, one blast-absorbing device may be placed adjacent another in a relatively secure manner.

It is further envisaged that the blast-absorbing devices may have tie rods or tie members, which allow adjacent devices to be secured to one another.

According to a second aspect of the invention, there is provided a blast protection structure comprising a plurality of blast-absorbing devices, each comprising a container having an inlet aperture through which material can be introduced into the container, said aperture being closable in order to retain the material within the container, wherein the material within the container is a

settable gel which provides a blast absorbing medium for the blast-absorbing device.

Such blast-absorbing devices include devices as previously described.

The blast protection structure may be provided as a wall between an object and a blast or it may be provided as a housing around a structure which could explode. When formed as a housing, the blast protection structure can contain blast from the explosion within a localised area i.e. within the confines of the housing provided by the blast protection structure.

In another preferred embodiment, it is envisaged that the blast protection structure comprises a combination of the blast-absorbing devices of the first aspect of the invention, together with containers that include a liquid. The liquid filled containers may be spheres or plastic containers that ideally are contained within or supported by a lightweight frame. It is envisaged that the liquid is water. The frame supporting the liquid filled containers may be placed in front of a wall of the gel filled blast-absorbing devices. However, it may be that a wall comprises a combination of blast-absorbing devices and liquid filled containers.

Preferably, the blast-absorbing devices and the liquid filled containers are supported by a frame. This may be a frame that is common to both types of containers or a separate frame may be provided for the gel filled containers and the liquid filled containers.

The frame may be formed of a lightweight material, such as aluminium, so that it can be transported and moved into position relatively easily. The frame may be provided as a structure, which can be assembled into a predetermined structure, for example a wall section. Alternatively, the frame may be assembled into structures as required by adding on additional frame sections to provide a structure having the desired dimensions to support the blast-absorbing devices needed to contain or protect against blast.

In a preferred arrangement, the blast protection structure comprises a multi-layer wall having an outermost wall formed of gel filled blast-absorbing devices and an inner wall, being positioned behind the outermost wall which is formed of liquid filled containers.

Such an arrangement allows the blast protection structure to have both blast-absorbing properties, this being provided by the gel containers and also, possible fire extinguishing properties that are provided by the facilities by the liquid-filled containers. In effect it is a dual action wall where if the blast is so severe that the gel containers are damaged, then the effect of the blast is also dampened by the liquid-filled containers.

According to a third aspect of the invention there is provided a scatter pattern monitoring device adapted to monitor a scatter pattern produced by materials released by an explosion, said scatter pattern monitoring device comprising one or more blast-absorbing devices each comprising a container having an inlet aperture through which material can be introduced into the container, said aperture being closable in order to maintain the material within the container, wherein the material within the container is a gel which provides a blast-absorbing medium for the scatter pattern monitoring device such that materials released by an explosion are contained within the gel on impacting with the or each container.

Preferably, the scatter pattern monitoring device is for monitoring the scatter patterns produced by ordinance being fired directly at the device. This may be to test weapons or missiles and how they react on impacting a surface. The missiles may be fired from guns or hand held missile launchers. However, the device may be constructed so that larger scale explosions can be monitored, for example, where missiles are launched from a tank or an aircraft. The scatter pattern monitoring device in this case would be constructed so that it has a large

enough surface area to absorb blast directed at it. As there would be more blast-absorbing devices needed to increase the surface area for larger explosions, a frame may be provided to support the blast-absorbing device. It may be that the blast-absorbing devices can also have integral hooks or ties so that they may be secured to each other or to the frame to provide a substantially secure structure for the target area for the explosion.

In addition to monitoring explosions aimed directly at the scatter pattern monitoring device, deflected blast from an explosion may be monitored. For example the device may be used to monitor blast patterns when an explosion occurs at various positions relative to the scatter pattern monitoring device. Such an arrangement may enable researchers to observe how blast is deflected, for example down a street when an explosion occurs. In areas where explosions are likely to occur, either as a result of an accident, e.g. a gas explosion or from terrorism, then blast-absorbing devices or structures as described may be positioned so that they deflect blast away from areas where members of the public are likely to be.

According to a fourth aspect of the invention, there is provided a blast-absorbing device comprising a container having an inlet aperture through which material can be introduced in the container, said aperture being closable in order to maintain the material within the container, wherein the material in the container is a gel which provides a blast-absorbing medium for the blast-absorbing device, said gel being reactable with a gel degrading material so that the gel is thereby converted to a liquid which may then be removed from the blast-absorbing device.

When a gelatine or starch based material is used for the gel, known enzymes capable of the degrading gelatine or starch are used. However, it may also be the case that chemicals can be used which degrade the gel material

physically, for example by bond degradation. Ideally, the chemicals used are those that do not degrade the container holding the gel.

Preferably, the feature of a having a degradable gel material can be provided for the blast-absorbing device, the blast protection structure and the scatter pattern-monitoring device as previously described.

In all embodiments of the invention, the gel used is preferably maintained in the gel form. In cold climates, to avoid freezing of the gel, inclusions such as diluted glycols, salt solutions or alcohol based solutions may be used to increase the freezing point of the gel to avoid it freezing.

For a better understanding of the invention, embodiments of the invention will now be described, by way of example only, with reference to the accompanying figures in which:

Figure 1 shows a cross sectional view of a blast-absorbing device according to the invention,

Figure 2 shows a cross section of a blast-absorbing device showing a device having upper and lower chambers,

Figure 3 shows a blast protection structure comprising blast-absorbing devices,

Figure 4 shows a cross section of a blast protection structure including a frame for supporting filled containers,

Figure 5 shows a frame that can be used with blast-absorbing devices of the invention to form a blast protection structure, and

Figure 6 shows a scatter pattern monitoring device according to an aspect of the invention.

A blast-absorbing device is generally shown as 1. The device 1 comprises an container 3, which is in a generally rectangular format, although other shaped containers may be used. The container 3 includes a set gel 2

made from a mixture of water and starch, such as that sold as RediBOND 4463A, and caustic soda (sodium hydroxide). Although the consistency of the gel 2 can be varied according to the proportions used it has been found that mixing 5% by volume of caustic soda gives satisfactory results, the mixture being initially a slightly viscose but pourable liquid which sets to a gel of a consistency similar to jelly or blancmange.

Towards the top of the container 3 is a cap 4 which covers an inlet aperture in the container and through which gel may be introduced. The cap 4 is located in an upper wall of the container for ease of filling but such may be positioned elsewhere, depending on what requirements are needed for access to fill the container 3. Multiple inlet apertures may be located at various points on the container so access points to fill the container may be selected.

The base of the container 3 includes a reinforcement layer 5, which provides added support for the container. The reinforcement layer 5, may be formed of a blast resistant armour, such as from Kevlar®. This reinforcement layer 5 also allows a filled container 3 to be dragged along the ground without impairing the ability of the container 3 to hold, at least initially, a pourable mixture including water before it has been caused to set to a gel through the use of the gelling agents as described above or other gelling agents, which may include locally occurring natural products such as rice, tapioca and sago which effectively act as thickening agents sufficient to prevent or inhibit the container 3 from losing most or all of its contents within a short period due to e.g. a knife attack.

As shown in Figure 2, the container 3 may be dissected by a dividing wall 6, which splits the container into upper and lower compartments. The compartments may be filled with materials having different properties, for example the lower compartment may include a gel of one consistency while the

upper compartment includes a gel of a different consistency. The two compartments may be separated by a valve 7, which will control flow of material between the compartments. The valve may be operated as a passive device or it may be activated by an external operator controlling the valve to allow filling of the compartments as required. Although two compartments are shown, there may be several compartments forming the container 3.

As shown in Figure 3, a blast protection structure may be formed of gel-filled blast-absorbing devices. The blast-absorbing devices may comprise differing size devices with smaller size devices 3a forming the walls of a housing while larger blast-absorbing devices 3b stack one above the other to form a roof of a housing for a blast protection structure. Such can provide a shelter for individuals or objects so that they may be shielded from e.g. explosions. Access to the blast protection structure can be through an opening in a wall and there may be additional apertures in the wall of the housing to allow hands or weapons to pass through.

Alternatively, the blast protection structure may form a blast containment structure which is built around an explosive object that is then be detonated. Debris from the blast is contained within the confines of the blast protection structure, so protecting individuals in proximity to the explosive device.

As shown in Figure 4, the blast protection structure may comprise adjacent walls1a, 1b of blast-absorbing devices 1 and containers 3. There may be a first wall of gel-filled containers 3b, in front of which is a further wall of water-filled containers 3a. The containers 3a, 3b are supported by a frame comprising an upright wall 8, which is positioned between walls 1a, 1b, the wall 8 having arms 9 resembling shelves along its length and which extend substantially at right angles to the upright. The arms 9 support the individual containers 3a, 3b of the walls 1a and 1b. The frame may be supported on or

driven into the ground so that a firm wall is provided for the blast protection structure.

Figure 5 shows a schematic view of a frame for supporting a blast protection structure as shown in Figure 3. The frame comprises uprights 8a, which may be driven into the ground. The uprights have support arms 9a at various positions and these support arms may be connected to the uprights 8a via joints 10. The uprights 8a may also have jointed sections allowing for the frame to be assembled and disassembled quickly and easily and also enable the structure to be folded into a compact structure for easy transport and storage. To assist in the ease of transport and storage, the gel filled bags may themselves be deflated by adding a material to the gel which allows it to degrade so that the gel may be removed from the bag by being poured.

In addition to providing a blast-absorbing device, the device for the present invention may also provide for scatter pattern-monitoring. A scatter pattern-monitoring device is shown generally at 1c in Figure 6 and is formed of a container 3, including a gel material. On impact with the container 3, particles of debris from an explosion will provide impact points 11 on the container 3 and at least some of the debris will be absorbed within the gel thereby stopping it passing through the other side of the container. This provides a readily identifiable pattern for the blast structure. The scatter pattern can then be analysed by ballistics experts to study e.g. the firing action of weapons.

It is to be understood that the above detailed description of the embodiments of the invention are provided by way of example only. Various details of design and construction may be modified without departing from the true spirit and scope of the invention as set out in the statements of invention.

Claims

1. A blast-absorbing device comprising a container having an inlet aperture through which pourable material can be introduced into the container, said aperture being closable in order to maintain the material within the container, wherein the material within the container is a settable gel which defines a blast absorbing medium for the blast-absorbing device.

2. A blast-absorbing device according to claim 1 wherein the gel is a gelatine-based or a starch-based composition.

3. A blast-absorbing device according to claim 2 wherein the gelatine or starch based composition is provided as a main component that is mixed with other materials, for example other gels, to provide a consistency appropriate for withstanding a blast or a particular type of blast.

4. A blast-absorbing device according to claim 2 or claim 3 wherein a mixture of gelatine and starch based materials are used.

5. A blast-absorbing device according to claim 4 wherein the mixture of different materials are contained within separate compartments of the blast absorbing device.

6. A blast-absorbing device according to any preceding claim wherein the gel has inclusions interspersed therein, such as gel or polymer beads.

7. A blast-absorbing device according to claim 6 wherein the beads are of a different consistency or viscosity from the surrounding gel, so providing areas within the container, which can react differently to blast.

8. A blast-absorbing device according to any preceding claim further containing particulates which contribute to absorbing blast and help to dampen shock waves.

9. A blast-absorbing device according to claim 8 in which the particulates are ash.

10. A blast-absorbing device according to any preceding claim in which the blast-absorbing medium further includes pockets of air.

11. A blast-absorbing device according to claim 10 in which the air is introduced as bubbles before the gel sets.

12. A blast-absorbing device according to any preceding claim wherein the blast-absorbing device comprises an inflatable container formed of a flexible bag divided into internal chambers in which one chamber is above another.

13. A blast-absorbing device according to any preceding claim wherein one or more of the chambers includes a reinforcement layer.

14. A blast-absorbing device according to any preceding claim wherein the container has one or more surfaces coated with a non-slip coating.

15. A blast-absorbing device according to any preceding claim wherein inflatable bags are used for the containers.

16. A blast-absorbing device according to any preceding claim wherein a blast protection structure comprising a plurality of blast-absorbing devices, each comprising a container having an inlet aperture through which material can be introduced into the container, said aperture being closable in order to retain the material within the container, wherein the material within the container is a settable gel which provides a blast absorbing medium for the blast-absorbing device.

17. A blast-absorbing device according to any preceding claim wherein a scatter pattern monitoring device adapted to monitor a scatter pattern produced by materials released by an explosion, said scatter pattern monitoring device comprising one or more blast-absorbing devices according to any preceding claim each comprising a container having an inlet aperture through which material can be introduced into the container, said aperture being closable in order to maintain the material within the container, wherein the material within the container is a gel which provides a blast-absorbing medium for the scatter pattern monitoring device such that materials released by an explosion are contained within the gel on impacting with the or each container.

18. A blast-absorbing device according to any preceding claim wherein a blast-absorbing device comprising a container having an inlet aperture through which material can be introduced in the container, said aperture being closable in order to maintain the material within the container, wherein the material in the container is a gel which provides a blast-absorbing medium for the blast-absorbing device, said gel being reactable with a gel degrading material so that the gel is thereby converted to a liquid which may then be removed from the blast-absorbing device.

19. A blast-absorbing device substantially as hereinbefore described with reference to any one of Figures 1 to 5.

20. A scatter pattern monitoring device substantially as hereinbefore described with reference to Figure 6.

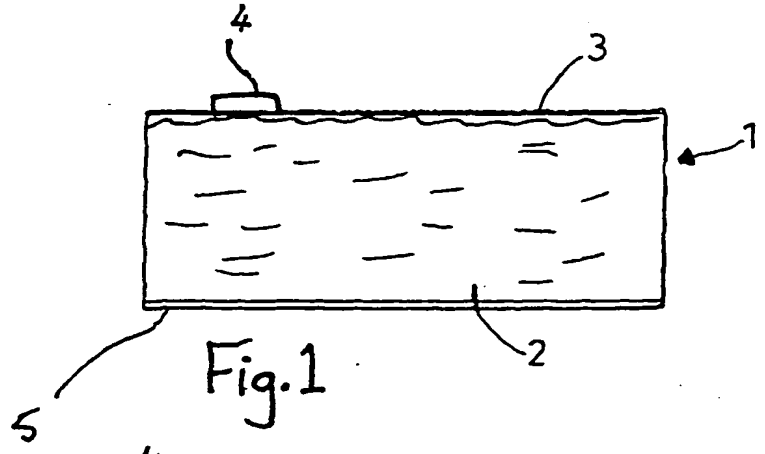

Fig.1

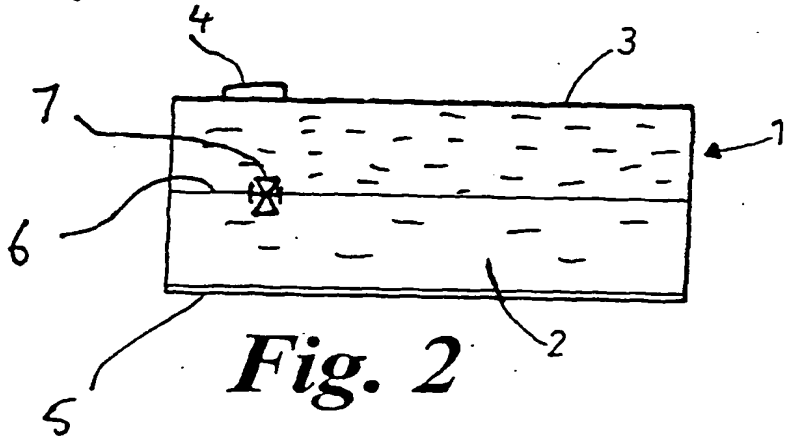

Fig. 2

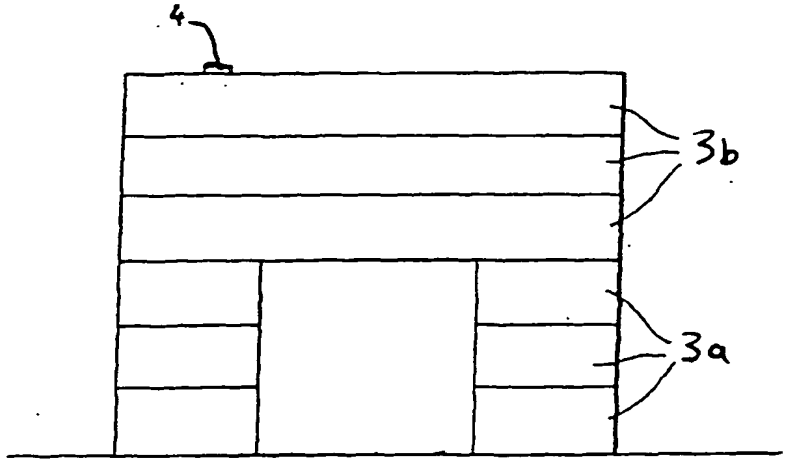

Fig. 3

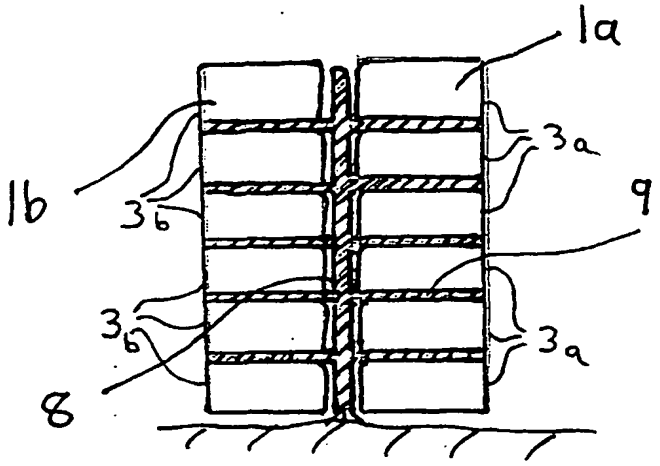

Fig. 4

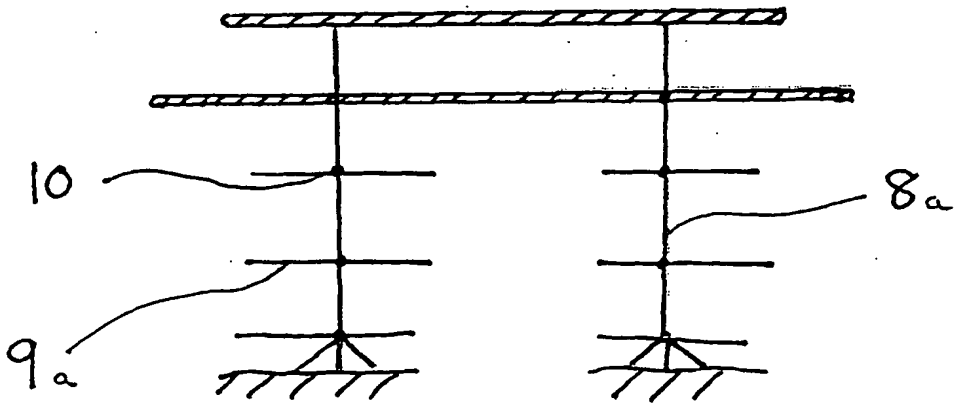

Fig. 5

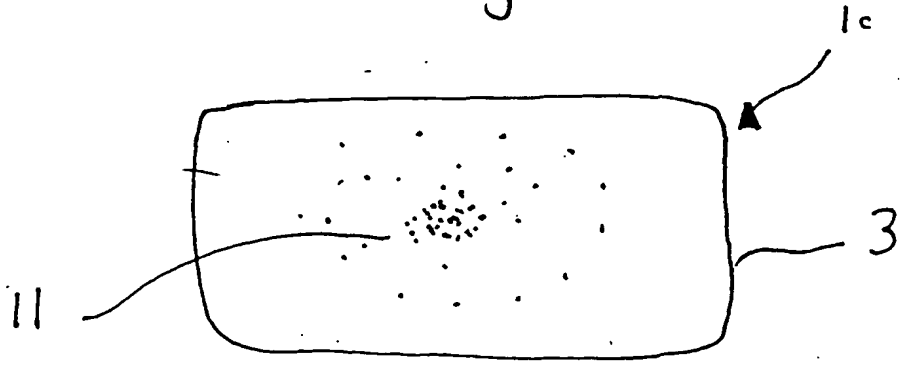

Fig 6

INTERNATIONAL SEARCH REPORT

Internatior ilication No
PCT/GB 03/04888

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F42D1/28 F42D1/20 F42D5/05 F42D5/045

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F42D F41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 394 786 A (HOMER JR VINCENT H ET AL) 7 March 1995 (1995-03-07) column 8, line 44-68 column 15, line 4 -column 16, line 47 column 19, line 59 -column 20, line 34 column 20, line 52 -column 21, line 15; figures 12-14	1,6-8, 10,11, 15-17, 19,20
Y	---	14
Y	GB 2 292 997 A (PARKES JOHN HUMPHRIES) 13 March 1996 (1996-03-13) page 2, line 33-31 page 4, line 9-14 page 5, line 30-35; figures 1-3	14

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
8 March 2004	15/03/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Van der Plas, J

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INTERNATIONAL SEARCH REPORT

Internatior ilication No
PCT/GB 03/04888

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 3 049 079 A (EILO CLYDE W) 14 August 1962 (1962-08-14) column 3, line 7-46 column 4, line 40-74; figure 2	1-5,17, 19,20
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A	DE 202 20 429 U (TDW GES FUER VERTEIDIGUNGSTECH) 17 July 2003 (2003-07-17)	

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB 03/04888

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